PB-215 106

# INDUSTRIAL WASTES PROBLEMS WITH REFERENCE TO SEWAGE TREATMENT

Hayse H. Black

Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

1958

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 215 106

# INDUSTRIAL WASTES PROBLEMS WITH REFERENCE TO SEWAGE TREATMENT

LIBRARY
SANITARY ENGINEERING CENTER
CINCINNATI, OHIO

By
Hayse H. Black
Industrial Wastes Consultant

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

Presented at 26th Annual Short Course
for
Water and Sewage Plant Operators
University of Florida
Gainesville, Florida
June 5, 1958

# INDUSTRIAL WASTES PROBLEMS WITH REFERENCE TO SEWAGE TREATMENT

The increasing number of new and renovated municipal sewage treatment works designed to treat trade wastes, clearly indicates the trend in waste treatment. This is a natural consequence of the continued search for economical methods for treatment of industrial wastes. There are many instances where the residual wastes from a manufacturing process can be most economically treated along with domestic sewage. There will be very few cases where industrial wastes, which are unsuitable for discharge to a sanitary sewerage system, can be released directly to a stream without some form of treatment. Although use of municipal sewerage systems may prove a convenient mea.. for industry to dispose of liquid wastes, it is imperative that equity be established in payment for this service.

## UNACCEPTABLE WASTES

Any waste which, either by itself or through reaction with another, interferes with normal functioning of sewers or the operation of a sewage treatment works, should be excluded from the sewers. Explosive and flammable substances are by their very nature prohibited. Liberation of certain dissolved gases can create a serious corrosion problem at the treatment works as well as annoy the operators. Toxic materials should be excluded unless they are diluted to concentrations which will not inhibit biological activity. Grease from meat packing plants has been known to partially clog sewers seriously reducing their capacity. Petroleum oils represent another type of waste which municipal plants are not equipped to handle. Control of industrial waste discharge to municipal sewerage systems is usually accomplished by regulations enforced by ordinance (1) (2) (3) (4).

## RESPONSIBILITY

In considering combined treatment of domestic and industrial wastes, it should be emphasized that this is a two-way affair requiring cooperation on the part of both the city administration and the industrial officials. There are many American municipalities where the local industries are truly the life blood of the community. Frequently, the manufacturing concerns will utilize local raw materials, provide permanent employment, and pay a major portion of taxes, which support the local government and the school system. It is not uncommon for the older plants to be completely surrounded by residential areas. This not only complicates waste treatment at the industrial site but also makes the construction of a new industrial sewer through the built-up section a costly operation. Under these conditions, the municipality should recognize that it has a definite responsibility to industry in the matter of waste treatment.

When trade wastes are accepted in the sanitary sewerage system, it is the responsibility of industry to control the process waste discharge to the sewers in such manner that combined treatment is feasible (5). This control may be facilitated by pretreatment at the factory. It is incumbent upon the industrial representative charged with waste control and treatment to become familiar with the operation problems of the municipal treatment works which provides his industry with this service. In addition, the industry must supply the treatment works superintendent with full information regarding the characteristics of trade wastes discharged to the sewers. Mutual interest is of major importance in contributing to success of combined treatment.

### Segregation of Wastes from Clean Waters

This is a relatively simple problem when considered as part of the design

for a new industrial plant. It becomes more complex and costly for the older plants having an intricate network of sewers and other underground conduits. Although the concentration of pollutional materials varies inversely with dilution, economies are usually realized by reducing the volume to a minimum.

Controlled Discharge

Through instrumentation and automatic controls, it is possible for industry to regulate each process with precision. An equally effective system of controls can be provided by industry to regulate discharge of process wastes and to maintain a continuous accurate record of the rate and period a given waste is released. Such a system of control precludes the interruptions at a municipal treatment plant inevitably caused by promiscuous dumping.

When flow equalization tanks at the industrial site are required, they should be so designed that sludge will not be retained. Retention in the equalization tanks should be held to a minimum consistent with optimum loading at the municipal plant. Extended storage of unstable wastes will encourage anaerobic decomposition which may cause odors to develop in the primary units.

Controlled discharge becomes increasingly important as the industrial load becomes a significant portion of the total waste load. In general, combined treatment is facilitated by maintaining the waste-sewage ratio reasonably constant. In waste treatment, like any process, it is highly desirable to keep the untreated waste as uniform in composition and volume as practicable (6).

Pretreatment

There is no unanimity of opinion regarding the desirability of or need for pretreatment. Some operators are agreeable to receiving most any treatable

waste that will pass through the sewers. Pretreatment is most valuable as a means of reducing the load on a municipal plant having limited capacity. Screening is the simplest form of pretreatment and is particularly applicable to vegetable canneries, tanneries, and paper mills. Sedimentation may be employed with or without chemicals but sludge disposal always presents a problem.

Grease is a nuisance in small sewers and at treatment plants. When present in quantity, it is advisable to recover as much as practicable at the source. Flotation devices are employed varying from simple grease traps to elaborate grease collectors using compressed air. Acid treatment is useful if the grease is in an emulsified state. The foregoing examples of pretreatment are typical but each case should receive individual study.

## TREATMENT WORKS DESIGN

The first requisite in considering combined treatment is the treatment works design. The Allegheny County Sanitary Authority's program is typical of a well organized plan for handling industrial wastes (7). This program and the treatment works design were based on thorough study of the wastes from thirty industries to be served, in addition to chemical examination of the discharge from thirty-two major municipal sewer outfalls. It is significant that all industrial wastes in the Pittsburgh area were considered acceptable for treatment except pickle liquor wastes and acid mine drainage.

The design of a sewage treatment works to receive both domestic sewage and a combination of industrial wastes frequently develops into a Herculean task. This is particularly true when the receiving stream requires a high degree of treatment. Review of the possible treatment systems available to the designing engineer is beyond the scope of this paper. It should suffice

to caution that such designs should allow for the maximum in flexibility of operation and should provide liberal reserve capacity.

## TREATMENT WORKS OPERATION

Treatment of sewage and industrial wastes covers any artificial process to which the wastes are subjected in order to remove or alter their objectionable constituents. The important fact is that we are dealing with a "process" and this spells operation requiring an operator. Regardless of how modern a waste treatment works may be or how well it may be designed for the particular job it is expected to do, its effectiveness will depend largely on the manner in which it is maintained and operated. The operator must know his plant, have full knowledge of the wastes to be treated, and understand the limitations of the waste treatment process to obtain continuous satisfactory performance.

### Primary Treatment

Sedimentation of a combined waste (industrial wastes and domestic sewage) may differ in any of several ways from a normal domestic sewage. Difficulties or differences that have been observed are due to a variety of causes, including:

1. Change in character of waste from decomposition in sewers
2. Variation in density and settling rate of suspended solids
3. Increase in floating material
4. Prevalence of odors
5. Solubility of suspended solids
6. Compacting of sludge
7. Sludge volume increase

Each problem should be thoroughly studied before operations are modified. There will usually be more than one way to improve each of these operation difficulties. In some cases, the relief from one condition may tend to aggravate another. Improved efficiency can be accomplished by chemical precipitation when this added cost is warranted. Use of coagulants increases the colume of sludge and materially alters its character.

Secondary Treatment

Stabilization of wastes by oxidation units is effected through aerobic biochemical action. The objective is to establish and to maintain the optimum environment for maximum biological activity. Efficient treatment requires control of such variables as: oxygen supply, organic load, pH, and temperature. Upsets are caused by waste combinations which rapidly change these variables.

The trickling filter is a consistently effective type of biological treatment. High-rate filters, with relatively high B.O.D. loadings, are applicable where a high quality effluent is not required. The "alternating double filter" developed by the British Water Pollution Research Laboratory constitutes still another modification (8).

Although the trickling filter can tolerate substantial variations in character of applied waste, it does possess some disadvantages, all of which are augmented by trade wastes. Because of odors, trickling filters are not considered suitable for built-up districts. Prolonged high organic loading tends to cause pooling; however, this can be alleviated by using larger rock, with possibly some loss of efficiency. "Psychoda" flies are often a serious pest.

Activated sludge is sensitive to substantial changes in character of

wastes and organic loading. Wastes high in carbohydrates are particularly detrimental to the process. These include dairy, brewery, corn canning, and starch. The high oxygen demand and rapid decomposition of these wastes, with production of organic acids, disrupts normal biological activity. Such wastes stimulate fungus growths which, if not controlled, cause "bulking".

Much research has been conducted in recent years in an effort to make the activated sludge process less sensitive to shock loads and to control the sludge index. Notable success has been achieved in this work by Kraus at Peoria, Illinois (9). The Kraus process consists of converting digested sludge to activated sludge in a sludge treatment aeration tank, after which it is interchanged with the activated sludge in the normal activated sludge part of the plant. This process not only eliminated sludge bulking at Peoria but also made it possible to apply greater loadings to the aeration tanks and higher settling rates in the final settling tanks than was possible with the conventional activated sludge process.

## DIGESTION

Sludge digestion units are provided to partially stabilize sewage solids so that dewatering and disposal may be accomplished without creating a nuisance. The anaerobic decomposition of organic solids is a seemingly simple process. However, the conditions for maximum rate of digestion must be controlled within reasonably narrow limits. It is not uncommon for solids from industrial effluents to materially alter these conditions resulting in very active digestion, or the reverse, cause biological activity to virtually cease. Important considerations in sludge digestion have been described by Schlenz and Buswell (10) (11).

REIMBURSEMENT FOR TREATMENT OF INDUSTRIAL WASTES IN MUNICIPAL PLANTS

The objective of engineers and administrators confronted with the problem of financing municipal waste treatment is to establish fair rates and rate structures which measure the benefits from and the use of the municipal sewage treatment works. The terms "rates" and "rate structures" have been defined by the Joint Committee (12) as follows:

"A rate structure is a statement, usually in tabular form, describing the rates and units to be used to compute the amount to be billed to each user and to each property benefitted by the works".

The Joint Committee has further enunciated the fundamental principle governing the determination of fair rates and rate structures for both water and sewage works:

"The needed total annual revenue of a water or sewage works shall be contributed by users and non-users (or by users and properties) for whose use, need and benefit the facilities of the works are provided approximately in proportion to the cost of providing the use and the benefits of the works".

Numerous articles have been published on the subject of charges for industrial waste treatment in municipal treatment works. These offer several different methods of approach. The majority of those who have written on this subject recommend that composition of the wastes be taken into consideration as well as the volume (13).

Some writers have advocated the incremental method of charging for industrial wastes (14). Others prefer to develop formulas in determining service charges (15).

In developing fair charges for treatment of industrial wastes, it would

seem prudent to conform to the basic principles set forth in the monumental cooperative report on rate structures for water and sewage service published by the Joint Committee consisting of the American Society of Civil Engineers, the American Bar Association, and other cooperating groups. Even these principles cannot be adhered to exactly in some states without a change of existing laws. Approximations based on a rational method are certainly more desirable than strict conformance with some formula that may be unfair.

## SUMMARY

There are numerous types and combinations of industrial wastes currently being successfully treated in municipal sewage treatment plants. There is reason to believe that this practice will be continued and expanded. Combined treatment should prove economically sound and industry will be more inclined to reduce process wastes when required to pay service charges. The progressive industrialist recognizes the expense of waste treatment as a legitimate cost of production.

## REFERENCES


1. Palmer, C. L., "Control of Sewer Usage at Detroit, Michigan," Sewage Works Journal, 18, 6, 1127 (November 1946).

2. Taylor, Dean M., "Industrial Waste Ordinances - Part I", Water and Sewage Works, 103, 8, 368 (August 1956).

3. Watson, Kenneth S., "1954 Industrial Wastes Forum", Sewage and Industrial Wastes, 27, 5, 587 (May 1955).

4. Hurwitz, E., and Jonas, M. R., "The Industrial Wastes Problems of The Metropolitan Sanitary District of Greater Chicago", Proceedings of the Eleventh Industrial Waste Conference, Purdue University, May 15-17, 1956, pg. 552-559.

5. Watson, Kenneth S., "Acceptance of Industrial Wastes in Municipal Sewer Systems", Industrial Wastes, 1, 1, 27 (Sept.-Oct. 1955).

6. Geyer, J. C., "The Effect of Industrial Wastes on Sewage Plant Operation", Sewage Works Journal, 9, 4, 625 (July 1937).

7. Laboon, J. F., "Industrial Wastes Disposal at Pittsburgh", Sewage and Industrial Wastes, 22, 4, 549 (April 1950).

8. Southgate, B. A., "Treatment and Disposal of Industrial Waste Waters", His Majesty's Stationery Office, London, England.

9. Krans, L. S., "Combined Treatment of Industrial and Domestic Wastes", Sewage and Industrial Wastes, 30, 2, 199 (February 1958).

10. Schlenz, H. E., "Important Considerations in Sludge Digestion, Part I - Practical Aspects", Sewage Works Journal, 19, 1, 19 (January 1947).

11. Buswell, A. M., "Important Considerations in Sludge Digestion, Part II - Microbiology and Theory of Anaerobic Digestion", Sewage Works Journal, 19, 1, 28 (January 1947).

12. Joint Committee Report, "Fundamental Considerations in Rates and Rate Structures for Water and Sewage Works", Ohio State Law Journal, 12, 151 (1951).

13. Schroepfer, George J., "Determination of Fair Sewage Service Charges for Industrial Wastes", Sewage and Industrial Wastes, 23, 12, 1493 (December 1951).

14. Round Table Discussion, "Charging for Treatment of Industrial Wastes", Municipal Sanitation, 3, 6, 251 (1932).

15. Symons, G. E., "Special Charge Formulas for Industrial Wastes in Municipal Sewage", Water and Sewage Works, 98, 4, R-116 (1951).